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Title: Application of Web-Based Tool AIDO to COVID-19

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Los Alamos NATIONAL LABORATORY

Application of Web-Based Tool AIDO to COVID-19

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LA-UR to be added

Background

- Analytics for the Investigation of Disease Outbreaks (AIDO)
  - Web-based tool
  - Enhance awareness on developing outbreaks
  - Aid mitigation decisions
  - 650+ historical outbreaks and their characteristics
  - 40+ diseases
- https://aido.bsvgateway.org/

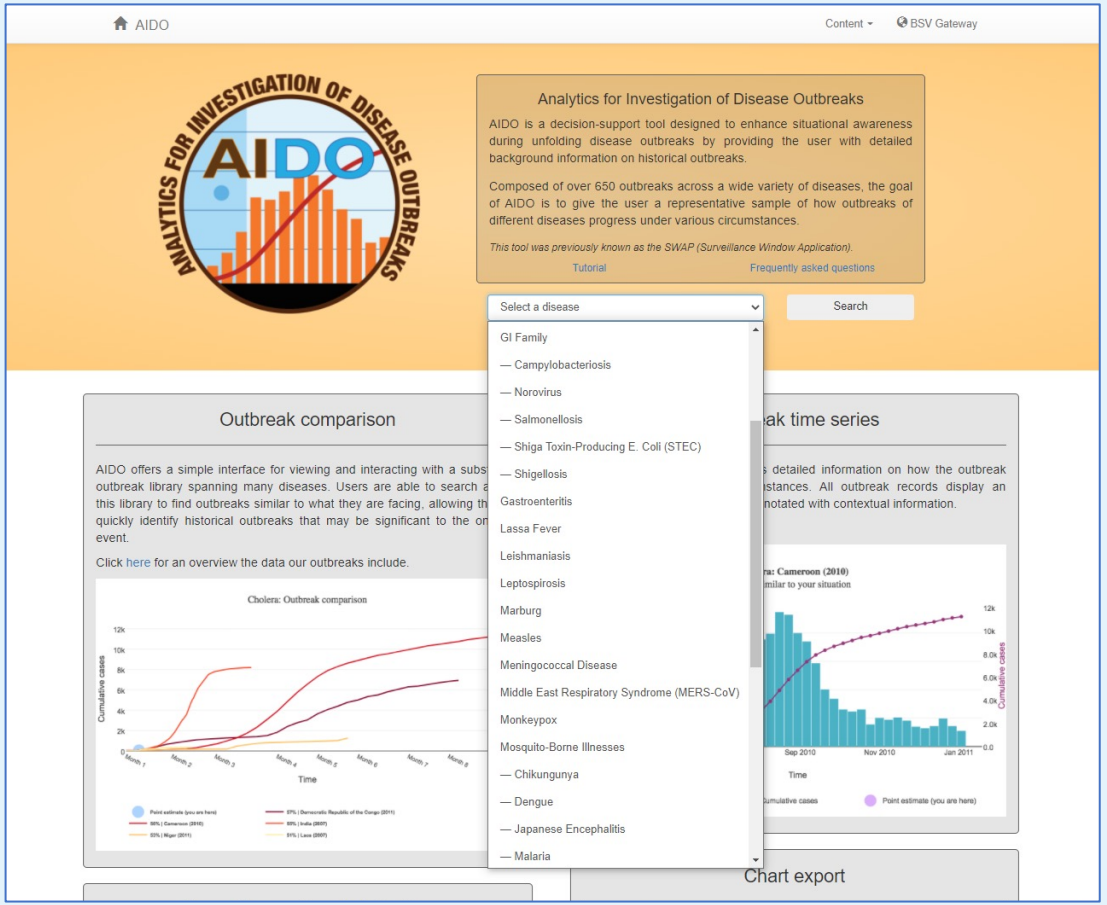


Photo taken from: Velappan et al. JMIR Public Health Surveillance 2019 Feb 25;5(1):e12032. doi: 10.2196/12032.

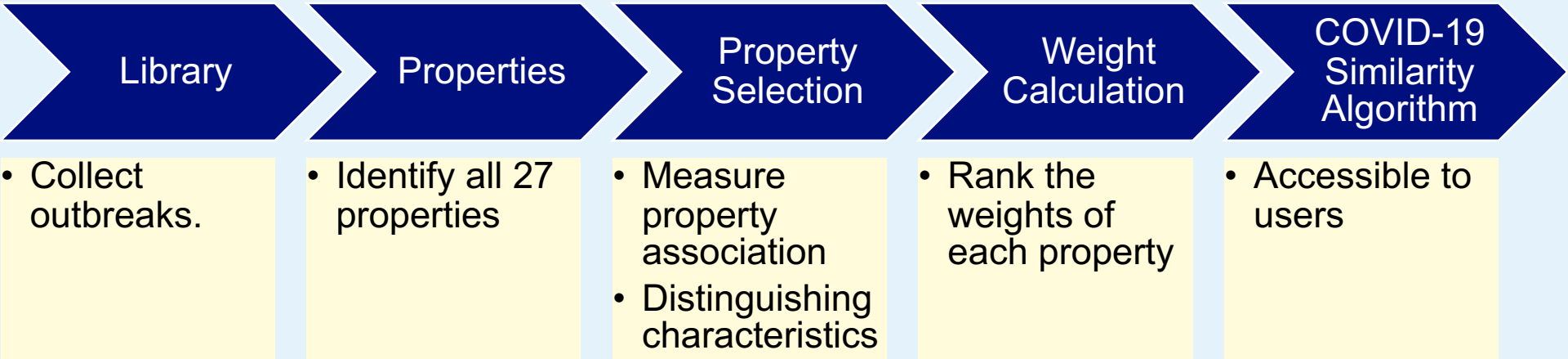
COVID-19 & Disease Surveillance

- Caused by SARS-CoV-2, severe acute respiratory syndrome coronavirus 2
- Lower/upper respiratory tract
- 196 M cases worldwide
- 4.19 M deaths
- Public health measures
- Prevention & mitigation

Photo taken from AAP News

Novel Nature of AIDO

- Similarity algorithm
- Input-specific: Matches unfolding outbreaks to historical outbreaks
- Compare values of unique properties



Constructing the COVID-19 Outbreak Library

- Time series of case counts
- Sufficient data for property analysis
  - 10+ cases
- Sufficient Metadata for outbreak annotation
- Variety of case counts, durations, circumstances, and locations

Property Collection

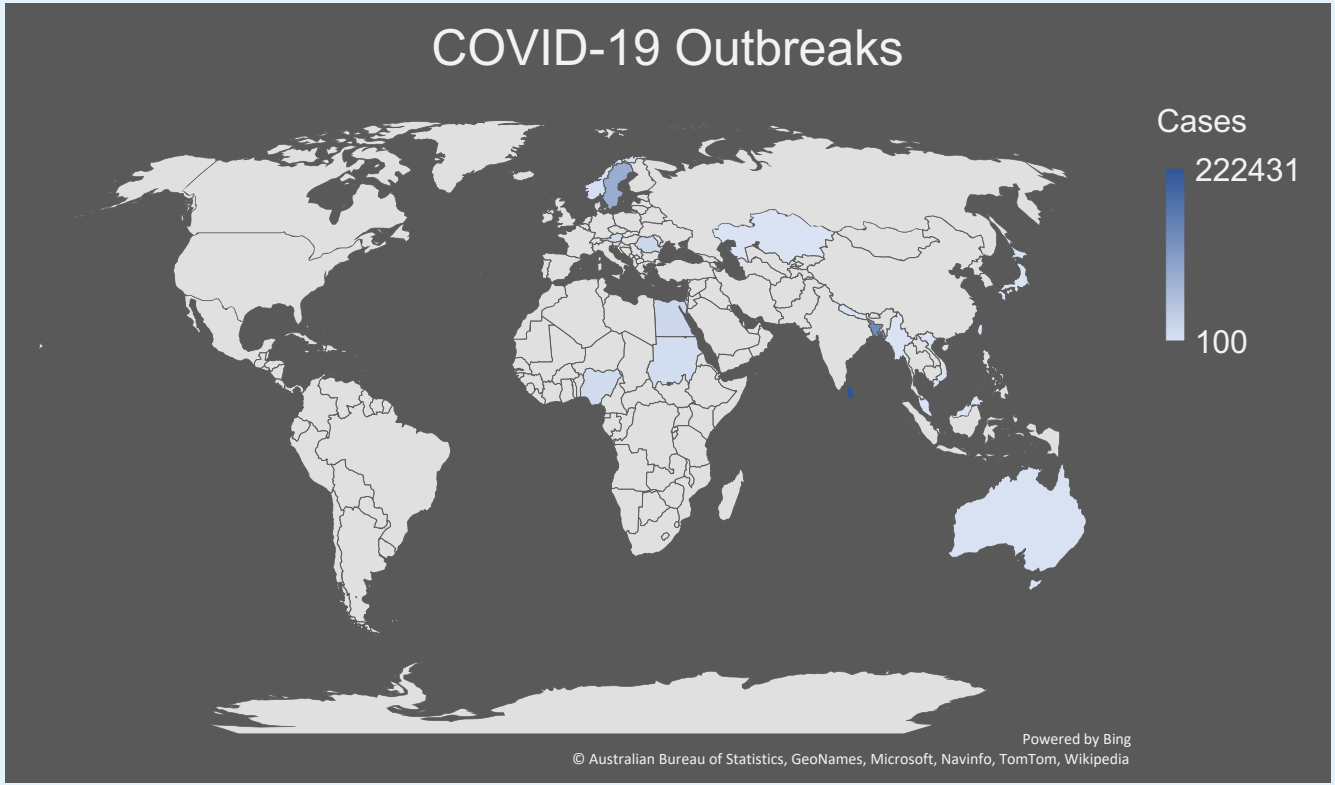
Population	Location	Disease
Population (continuous)	Climate	Pathogen source
Population (categorical)	Season	Outbreak curve
Disease status	Precipitation	Vector type
Rural/urban	Rainy/dry	Case fatality rate
Age stratification	Natural disaster	Attack rate
Special population group	Human Development Index (HDI)	Case definition
Vaccination status	Physician Density	Disease presentation classification
Population movement		Animal contact
Sex		Contamination Source
		Transmission mode
		Outbreak source proximity
		Outbreak pathogen

Statistical Tests to Select Properties

	Test	Purpose
1	Shapiro-Wilk Test	Normality • Is sample normally distributed?
2	Brown-Forsythe Test	Homoscedasticity • Is the properties' variance equal throughout all the data?
3	Tests of Association for property with case count / duration • T-Test • One-way analysis of variance (ANOVA)	Statistically Significant difference • Keep properties with a significant association

Expanding the Database with COVID-19 Outbreaks

- 19 outbreaks
- 100 - 222,431 cases
- 19 – 213 days
- 5 WHO regions



Features of COVID-19 Outbreak Library

- Critical to collect diversity of outbreaks from cruise ships to countries
- Range in duration of outbreaks aids case progression modeling
- Emerging data on vaccinations and outbreaks
- Constant patterns across properties:
  - Person to person transmission
  - Propagated outbreak curve
  - Nonendemic

Statistical Analyses

Population	Location	Disease
Population (continuous)	Climate	Pathogen source
Population (categorical)	Season ANOVA p-value < 0.05	Outbreak curve
Disease status	Precipitation	Vector type
Rural/urban	Rainy/dry	Case fatality rate
Age stratification	Natural disaster	Attack rate
Special population group	Human Development Index (HDI)	Case definition
Vaccination status Correlation > 0.3	Physician Density Correlation > 0.3	Disease presentation classification
Population movement		Animal contact
Sex		Contamination Source
		Transmission mode
		Outbreak source proximity
		Outbreak pathogen

Conclusion

- Statistical approach to selecting properties
- **Match** developing outbreak to historical COVID-19 outbreaks
  - Model case progression
  - Present examples
  - Support mitigation actions
- Key properties: Physician density, season, vaccination status
- AIDO is accessible and free on the internet

Photo taken from UNSW Sydney, by Shutterstock

Future Work

- Expand COVID-19 library to outbreaks with
  - variety of vaccinations, locations, vaccinated populations, and cases with variants.
- Track pre/post vaccination outbreaks in the same area for clearer comparison
- Determine rank of weights for each property
- Develop similarity algorithm
- Add visual analytics

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